SCHOOL OF
CIVIL ENGINEERING

INDIANA
DEPARTMENT OF TRANSPORTATION

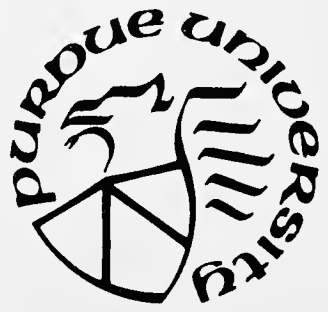
Joint Highway Research Project

Draft Report

Manual of Traffic Impact Studies

Soumya S. Dey and Jon D. Fricker

FHWA/IN/JHRP - 92/5



PURDUE UNIVERSITY

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MANUAL OF TRAFFIC IMPACT STUDIES

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LIST OF EXHIBITS

FOREWORD

This manual, entitled "Manual of Traffic Impact Studies", is a product of an HPR study called "Guidelines for Traffic Impact Analysis of Developments Along State Highways". The study was conducted by the Joint Highway Research Project (JHRP) in the School of Civil Engineering at Purdue University in conjunction with the Indiana Department of Transportation (INDOT) and the Federal Highway Administration (FHWA).

At the time the study was undertaken, a need was identified to establish a standardized procedure or guidelines for requesting, preparing and/or reviewing a traffic impact study for a proposed development that would affect state highways. Cases of rezoning and building permits were handled at the local level (city or county), each of which had their own guidelines for such studies, if any. INDOT handled new developments when access driveway permits were necessary. Often, INDOT is not involved in the transportation aspects of a site's development until access permits are requested for access to state routes. This can occur too late in the development's construction for any traffic-related problem to be remedied as effectively and economically as they could have been in the planning stage. Also the need for greater coordination between the INDOT and the local agencies in this matter was felt.

This manual is a first step in this direction. It is designed to be compatible with the Applicant's Guide and Procedure Manual for Transportation Impact Studies for Proposed Development for the City of Indianapolis [21,22].

The ideas and concepts in this manual borrow from the composite experience and effective procedures of numerous agencies and practitioners. It also incorporates, and in some cases enlarges and adjusts upon, accepted procedures as documented in other standard references, especially:

- ITE Recommended Practice- Traffic Access and Impact Studies for Site Development [1]
- Transportation and Land Development [2]
- Site Impact Traffic Evaluation Handbook [3]
- ITE Trip Generation [5]

The manual also recognizes that traffic impact analysis is a site-specific issue that can depend on many variables like the amount and type of data available and certain other locational parameters. Instead of prescribing a specific procedure for every step, it gives, in most of the cases, various options to obtain specific results. Therefore, it allows enough flexibility to the study preparer to use innovative methods based on sound engineering judgment. However, this should be done with the prior consent of the study reviewer(s).

The study Advisory Committee assisting in the preparation of the manual comprised of:

- R. Cales (INDOT)
- M. Newland (INDOT)
- J. Poturalski (INDOT)
- E. Ratulowski (FHWA)
- C. Venable (INDOT)

Input is expected from a panel of consultants, developers and local government officials before the final draft of the manual is prepared.

CHAPTER I

INTRODUCTION

One of the fundamental aspects of transportation planning is the interdependency of land use and transportation. The pattern of land use is affected by the level of accessibility provided by the existing transportation system. Any new development leads to the production and/or attraction of trips and thus creates new travel demands. Hence there is a need for improvement of the existing transportation facilities -- either in the form of new infrastructure or in the form of improved operational conditions. Such improvements, in turn, make the land more accessible to the existing activity centers and the attractiveness of the land increases. This spurs new developments, and the cycle starts again. This process continues until some kind of equilibrium is attained.

In the short-run, however, the predominant influence is that of land use on transportation [24]. Consequently, there is a need for a standardized methodology to assess the infrastructure or operational improvements needed for the transportation system.

Traffic Impact Analysis (TIA) is a specialized study of the impact that a given type and size of new land use has on the nearby transportation system.

One of the major transportation issues addressed in the 1980's has been the growing concern about the transportation

infrastructure not being able to keep pace with development. This imbalance between transportation supply and demand has resulted in congestion, delay and safety hazards at many locations throughout the country. As a result, traffic impact analysis is becoming more popular as a planning tool so that effective mitigating measures can be taken in advance. In fact, in some regions, a traffic impact study is mandatory for any developments larger than a few single family dwelling units.

PURPOSE OF TRAFFIC IMPACT ANALYSIS

The main purpose of traffic impact analysis are [22]:

1) To ascertain the operational conditions on the adjacent roadway network when a proposed development is accommodated within the existing transportation infrastructure along with other proposed developments (as reflected in the Comprehensive Development Plan).

2) To identify transportation improvements required to maintain the existing operational conditions.

3) To determine whether access to the proposed development will hamper traffic operations and safety near the site.

4) To identify present or future transportation system deficiencies without the new development.

5) To provide decision makers with a basis for assessing the transportation implications of approving proposed zoning changes and development applications.

7) To provide a basis for estimating the cost of proposed mitigating measures. Consequently, a traffic impact study can

be used to determine the "fair share" of the improvement cost to be paid by the developer.

PURPOSE OF THE MANUAL

This manual is intended to establish a standard methodology for traffic impact analysis. This would result in consistency in study requests, preparation and review. Such a standardized procedure would be beneficial to everyone involved in the development process. First and foremost, the manual will take the study preparer through a step-by-step procedure and enable him to present the study findings and recommendations in a systematic manner consistent with the reviewer's expectations. Second, it will enable reviewers to review the study in a systematic manner. Finally, it will promote understanding and awareness of transportation related issues among those involved in the development procedure.

The manual is not intended to make things more complicated and time-consuming. On the contrary, in the long-run, as the assumptions and procedures become accepted practice, the time involved in the process will decrease for both parties.

ORGANIZATION OF THE MANUAL

The manual is organized into small chapters, each corresponding to an important activity in the study process.

Chapter 1 provides an overview of traffic impact analysis.

Chapter 2 describes the different steps involved in the proposed traffic impact analysis methodology.

Chapter 3 describes the preliminary study process.

Chapter 4 describes the warrants for a complete traffic impact study.

Chapter 5 contains the warrants and analysis required for an operations analysis.

Chapter 6 deals with the topics to be addressed in the initial meeting between the study preparer and reviewer(s).

Chapter 7 describes reviewer and preparer qualifications.

Chapter 8 discusses methods of estimating non-site traffic in the horizon year.

Chapters 9, 10 and 11 give methods of trip generation, trip distribution, and traffic assignment, respectively.

Chapters 12 and 13 describe how to handle pass-by trips and make adjustments for mixed-use developments.

Chapter 13 gives the analysis involved in the study process.

Chapter 14 describes the study findings and recommendations.

Chapter 15 gives guidelines about report format.

Chapter 16 describes the staff review process.

CHAPTER II

STUDY PROCEDURE

Typically a traffic impact study (TIS) should be considered in conjunction with an application for approval of any of the following [1,28]:

- zoning changes
- subdivision/platting
- site plan
- building permit
- driveway (access) permit
- comprehensive plan amendments requested by the developer

However, INDOT gets involved in the traffic impact analysis procedure only when access permits are requested for driveway access to state highways.

The proposed methodology of traffic impact analysis will be a one-, two-, three-, or four-step process depending on the type of development under consideration. The different stages of a traffic impact study procedure are discussed below.

Step 1. A preliminary study will be required of all developments meeting certain "preliminary warrants". These are discussed in Chapter 3 of the manual. If the development under consideration does not satisfy the preliminary warrants, no further study is required and the TIA procedure stops here.

Step 2. From the findings of the preliminary study it will be decided if the "warrants for a complete TIA" (Chapter 4) are met. If the warrants are satisfied then a detailed traffic impact analysis (discussed in Chapters 8 through 15) will be required for the development. If the warrants are not satisfied, go to Step 3, otherwise go to Step 4.

Step 3. This step involves determining whether the warrants of an operations analysis are met. If the warrants are met, then an operations analysis has to be conducted (Chapter 5). If the warrants for operations analysis are not met, the study procedure stops here. Else go to step 4.

Step 4. This involves the staff review (Chapter 16) of the traffic operations analysis or the traffic impact analysis. If the study is satisfactory, the process stops here. Else, the revisions suggested have to be incorporated and send back for further review. This is the last step of the study process.

Figure 2.1 is a flowchart showing the different stages of a traffic impact study.

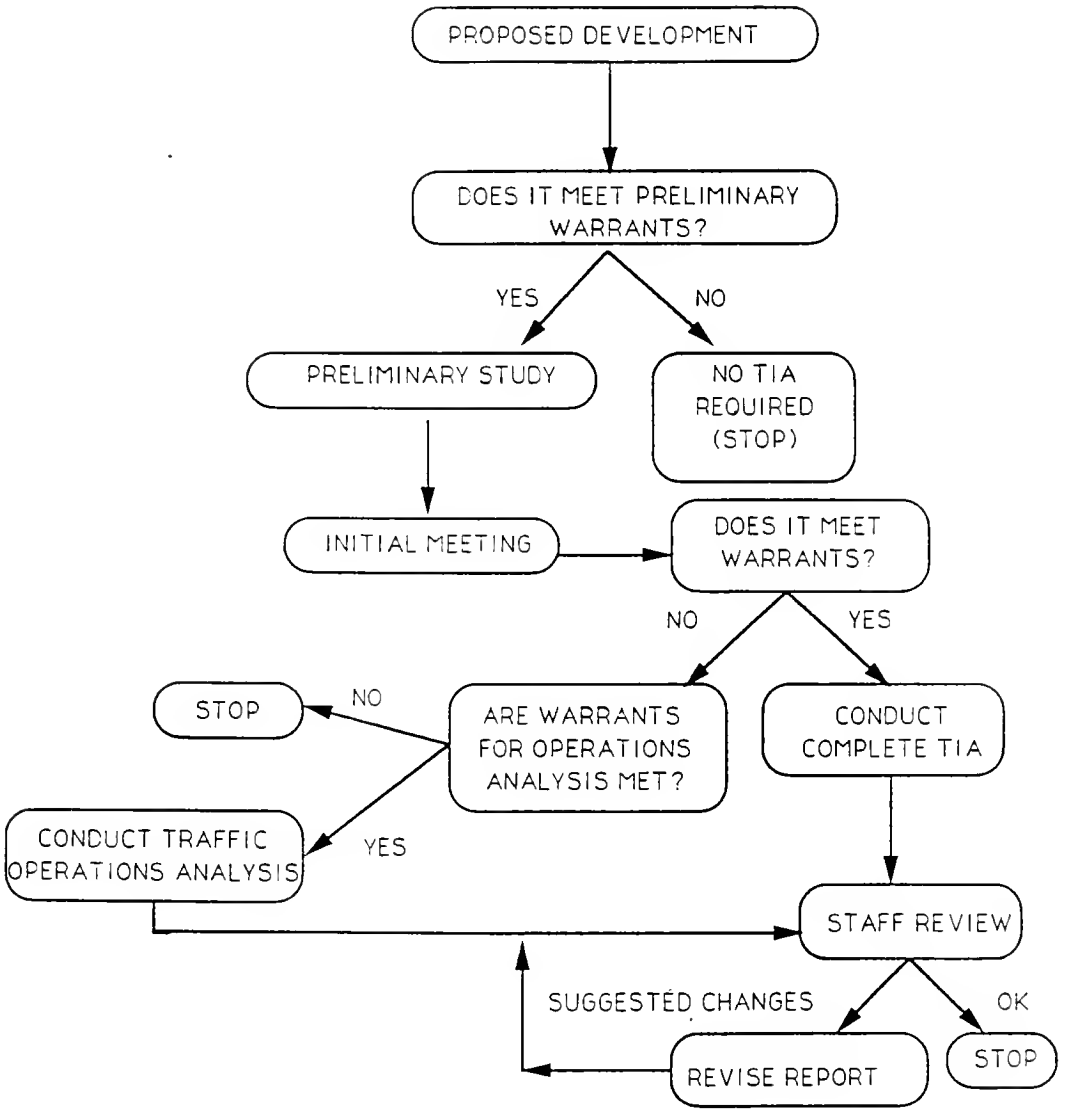

Figure 2.1 Flowchart Showing the Traffic Impact Study Procedure

CHAPTER III

PRELIMINARY STUDY

PRELIMINARY STUDY

A preliminary study will be required of all developments meeting the preliminary warrants for traffic impact analysis. The preliminary study should include:

- the type of development
- the complete site plan, with the site's access points and the nearest signalized intersection in each direction
- a market study (if applicable)
- trip generation, trip distribution and traffic assignment
- existing level-of-service of the adjacent roadway(s) including the nearest intersections in each direction if they are within a reasonable distance of the site (1/2 to 3/4 mile or one cycle length of travel time, whichever is more).
- horizon year level-of-service with and without proposed development

The preliminary study need not be a detailed analysis of the present and future conditions. No elaborate data collection effort or computer modeling is necessary for such a study. It is intended to provide an approximate analysis of existing and anticipated traffic conditions and is supposed to provide some foundation on which to base the discussion during

the initial meeting. The state department of transportation or the local transportation agency may be contacted for any existing data that are available to conduct such an analysis.

The preliminary study should be submitted along with the petition for an access permit.

PRELIMINARY WARRANTS

A preliminary study will be required of all developments meeting the 'preliminary warrants'. The preliminary warrants are based on certain predictor variables associated with the proposed development (at full "build-out"), such as gross floor area, acreage, etc. Table 3.1 shows the quantitative thresholds of the predictor variables for different land uses. Developments having land use intensity greater than the threshold values qualify for the preliminary study.

Table 3.1. Preliminary Warrants for Traffic Impact Analysis

LAND USE TYPE	ITE CODE	QUANTITATIVE THRESHOLD
Residential	210, 220, 222, 230, 270	150 Dwelling Units
Retail	814, 815, 820	15,000 square feet
Office	710, 714, 715, 750,770	35,000 square feet or 3 acres
Industrial	110, 120, 130, 140	70,000 square feet or 9 acres
Educational	520, 530, 550	30,000 square feet or 250 students
Lodging	310, 312, 320	120 occupied rooms
Medical	610	46,000 square feet

Special generators with high trip generation rates like parking garages, banks (both drive-in and walk-in), fast food restaurants, service stations with convenience stores, etc. will be required to submit a preliminary study, unless a waiver (for roads not under INDOT jurisdiction) is obtained from the local public transportation agency (city, county, etc.) concerned. The reviewer(s) will decide whether or not a waiver is justified based on experience and engineering judgment.

For developments which cannot be grouped under one of the land use categories given in Table 3.1 or discussed in the previous paragraph and for mixed-use developments, the trip generation rates should be determined using the latest available edition of the ITE Trip Generation report. If the development under consideration produces more than 50 peak hour peak direction vehicle trips, then the preliminary warrants are satisfied. For developments that generate a lot of truck traffic, the truck trips should be converted to equivalent vehicle trips.

Developments that do not meet the preliminary warrants will not be required to conduct any traffic impact analysis.

REPORT FORMAT

A sample report format for the preliminary study is shown in Appendix A.

CHAPTER IV

WARRANTS FOR A COMPLETE TIA

A complete transportation impact study will be requested for any development that meets:

a) Warrant 1 and Warrant 2

b) Warrant 1 and Warrant 3

c) Warrant 4

Warrant 1. Land Use Intensity

This warrant is satisfied when a development generates more than 100 peak hour peak direction trips.

Warrant 2. Level-Of-Service Warrant

This warrant is satisfied if the the traffic generated by the proposed development causes the level-of-service of the adjacent streets/intersections to drop by one letter grade. Level-of-service determination should be in accordance with the procedures described in the Highway Capacity Manual [13].

Warrant 3. Roadway Modifications

This warrant is met when the proposed development is expected to significantly impact a roadway segment identified in the Transportation Improvement Program for improvement. This criterion is also met when the proposed development includes modifications to the roadway system. Modifications include addition of lanes to accommodate site-generated

traffic, addition of exclusive turning lanes, acceleration/deceleration lanes, median openings, installation of traffic signals and other traffic control devices, etc.

Warrant 4. Special Cases

This warrant is satisfied if the preliminary study reveals that the traffic generated from the proposed development will create safety, operational or some other traffic problems. Whether or not a development meets this warrant should be decided at the initial meeting.

CHAPTER V

TRAFFIC OPERATIONS ANALYSIS

Typically a traffic operations analysis is conducted whenever a proposed development compromises the existing design standards and therefore might cause safety and operational problems in the immediate vicinity of the site. The analysis should be done for the entire system and not just the driveway or access point under consideration. A traffic operations analysis might include:

1) Study of proposed driveway locations, resulting sight distances, queueing provisions etc.

2) Safety analysis

3) Traffic signal warrants and progression analysis

4) Delay analysis

5) Gap studies

WARRANTS FOR TRAFFIC OPERATIONS ANALYSIS

A traffic operations analysis will be required if one or more of the following conditions are satisfied:

1) A development generates more than 25 turning movements per hour.

2) Request for new or modified driveways near intersections, interchanges or on roads where the posted speed exceeds forty miles per hour.

3) Requests or probable need for a new (or modified) traffic signal to control driveways or streets serving a proposed or existing development(s).

4) Existing sight distance limitation or high accident location near the site.

5) Requests for median openings on high speed facilities (posted speed limit >40 mph)

CHAPTER VI

INITIAL MEETING

The discussions in the initial meeting between the study preparer/developer and the reviewer will be based on the findings of the preliminary study. The meeting will serve the following purposes:

1) To decide whether a detailed traffic impact study or traffic operations analysis is required for the proposed development.

2) If further studies are required, the meeting will help the study preparer to assess the reviewer's expectations.

3) To discuss critical issues like extent of the study, study area, horizon years, time periods to be analyzed, data sources and availability, etc.

4) To ensure that all relevant issues are adequately addressed in the traffic impact study.

If a traffic impact analysis is warranted, some of the issues that need to be addressed in this meeting are discussed below.

STUDY AREA

Identification of an optimum study area is a pre-requisite to a proper TIA. An inappropriately large study area will unnecessarily increase cost and time. A small study area will fail to address the full impacts accurately. Any TIS should include at least all site access points and major intersections adjacent to the site. The first signalized intersection on each street serving the site should also be analyzed, if it is within 1/2 mile or one cycle length of travel time of the site. Beyond this area, the review agency and the preparer should collectively determine any additional area to be analyzed based on site specific issues. Sound engineering judgment should be used to include all areas that may directly or indirectly be impacted by the proposed development.

HORIZON YEAR

The horizon year of a TIS should refer to the anticipated completion date of the proposed development assuming full build-out and occupancy.

TIME PERIODS TO BE ANALYZED

The critical time period for any development will be directly associated with the peaking characteristics of both the development and the adjacent roadway system. These two peak periods may overlap. In cases where they differ, the time periods that result in the two highest cumulative directional traffic demands should be used to assess the impact of site traffic on the adjacent roadway system and to define the changes in roadway configuration and traffic control measures needed in the study area. In many cases, both the street and site peaks have to be analyzed in addition to the two highest cumulative peak periods to ensure not only acceptable opera-

tional levels on the roads but also provisions for driveway capacity, turn lane and queueing. Special consideration should be given to developments like shopping centers, which might peak after the adjacent street peak or on a Saturday.

Unless decided otherwise, the following time periods should be considered:

i) AM and PM street peak (weekday)

ii) AM and PM site peak (weekday)

iii) Noon peak (weekday)

FUTURE OFF-SITE DEVELOPMENTS

Most studies will have to take into account future off-site developments to ascertain the "base condition" in the horizon year. Off-site developments may be categorized under two broad headings:

Approved developments comprising the developments for which zoning already exists and hence the land use intensity can be estimated.

Anticipated developments consisting of those that are expected by the local agencies, based on the current comprehensive plan anticipated in the horizon year. These may include land uses not permissible under present zoning regulations.

The future off-site developments within the study area should be realistic and consistent with recent development trends. These should be available at a level of detail (by land use classification, intensity and location) appropriate for the required transportation study.

Both the reviewer and the study preparer should agree on off-site development assumptions for the horizon year. In case of a failure to reach an agreement, the reviewer will designate the quantity, type and location and types of developments to be assumed in the study.

DISCUSSION CHECKLIST

A discussion checklist has been provided in Appendix B to aid both the parties in recording information and comments. However, the discussions should not be restricted to the issues addressed in the checklist. The checklist has been developed in line with the one used by the City of Indianapolis. Larger developments in densely developed areas will need more in-depth discussion, while smaller sites might not need discussion on many of the issues in the checklist.

MEMORANDUM OF UNDERSTANDING

Immediately after the initial meeting, the study preparer should submit a memorandum of understanding confirming the following [21]:

- issue to be addressed in the study
- study procedure
- assumptions
- data sources
- report content
- other pertinent issues discussed in the initial meeting

The memorandum should request concurrence by the reviewing agency staff.

STAFF CONCURRENCE

The reviewing agency should review the contents of the memorandum. If they agree, they should communicate staff concurrence to the preparer. This should be done in writing.

FIELD RECONNAISSANCE

The preparer should initiate the study by a preliminary survey of the study area and the proposed site to get a feel for the site characteristics, traffic patterns, surrounding land uses, traffic control devices and geometric features of the site and surrounding roadways.

Table 6.1 gives typical data collection and field reconnaissance items.

Field reconnaissance should preferably be done before the initial meeting, so that site-specific issues can be adequately addressed at the meeting.

REVIEWER RESPONSIBILITY

To ensure that all the relevant transportation issues are addressed in the study, the reviewer should have a fairly good idea about the type, location and intensity of the proposed development, adjacent roadway, peaking characteristics of traffic in the study area, proposed and anticipated developments in the study area, existing and anticipated zoning, available data sources, anticipated roadway and transportation system improvements in the horizon year and other relevant issues.

Table 6.1. Typical Data Collection and Field Reconnaissance Items

■ Peak Period (site and street) turning movement counts
■ Adjustment factors to relate count data to design period
■ Machine counts to verify peaking characteristics
■ Primary traffic control devices
■ Signal phasing and timing
■ Roadway configurations
■ Geometric features (curves,grades)
■ Lane usage
■ Sight distance
■ Parking regulations
■ Street lighting
■ Driveways serving site across from or adjacent to site
■ Transit stops
■ Adjacent land use

Source: Traffic Access and Impact Studies for Site Development, Proposed Recommended Practice, ITE, Washington D.C., 1991 (Final Report)

Table 6.2 lists typical data that might be needed for a traffic impact study.

Table 6.2. Typical Background Data Needed for a Complete Traffic Impact Study [Source: Ref.1]

Category	Data
Traffic Volumes	■ Current and historic daily and hourly volume counts ■ Recent intersection turning movement counts ■ Seasonal traffic variations, if relevant ■ Relationship of count day to both average and design days, if relevant ■ Projected volumes from previous studies or regional plans
Land Use	■ Current land use densities and occupancy in the vicinity of the site ■ Approved projects, planned completion dates, densities and land use types ■ Prevailing development densities in study area ■ Anticipated developments on other undeveloped parcels, completion dates,etc. ■ Comprehensive land use plan ■ Zoning in vicinity
Demographics	■ Current and future population and employment within study area by zone
Transportation System	■ Current street system characteristics ■ Roadways ■ Truck routes ■ Route governmental jurisdiction ■ Traffic signal locations, timings, co-ordination ■ Adopted regional plan ■ Planned roadways and improvements in the study area ■ Transit service and usage ■ Pedestrian and bicycle routes ■ Available curb and off-site parking ■ Obstacles to the implementation of planned projects ■ Implementation timing for study area transportation improvements
Other Transportation	■ O-D data ■ 3 years accident history for accident-prone intersections

CHAPTER VII

PREPARER AND REVIEWER QUALIFICATIONS

PREPARER QUALIFICATION

Traffic impact studies should be prepared by a transportation professional with training and experience in traffic engineering and transportation planning. It must be supervised by a registered professional engineer with experience in traffic engineering operations.

REVIEWER QUALIFICATION

The traffic impact study shall be reviewed by one or more of the professional staffs of the Department of Transportation and any other participating agency (Department of Metropolitan Development, Department of Planning, City, County etc.) who collectively have training and experience in traffic impact study methodology, land use planning and traffic engineering, including traffic safety and operations.

ETHICS AND OBJECTIVITY

Although study preparers and reviewers might have different objectives and perspectives, they should adhere to established engineering ethics (similar to the Canon of Engineering Ethics) and conduct all analyses and reviews objectively and professionally.

CHAPTER VIII

NON-SITE TRAFFIC ESTIMATE

For estimating the traffic impacts of a proposed development, it is essential to analyze the traffic conditions on the horizon year roadway network for 2 cases: (a) with the proposed development and (b) without the proposed development. The incremental impacts are attributed to the site- generated traffic. For this, we have to establish the "base condition". The base condition will correspond to the traffic that would exist in the study area in the horizon year without the proposed development. This traffic is commonly referred to as non-site traffic. Non-site traffic may be of two kinds [2]:

a) Through traffic, which has neither an origin nor a destination in the study area.

b) Traffic that has either origin or destination or both in the study area. This traffic is generated by other developments in the study area.

Non-site traffic estimation may be done by one of three methods [1]:

I. BUILD UP METHOD

The basic concept of this method is to estimate the traffic generated by the proposed developments in the study area and to add it to the projected through traffic. If the site under consideration is being redeveloped, the existing

site traffic should be subtracted from the total to yield the future non-site traffic. The following steps should be followed.

a) Identify Transportation System Improvements -- Transportation system improvements that are proposed, committed and probable in the study area within the horizon year should be identified. The resultant changes in modal splits and travel patterns should be recognized.

b) Identify Study Area Developments -- All approved and probable developments in the study area before the horizon year should be identified by land use type, intensity and location.

c) Estimate Trip Generation -- The trip generation rates of the land uses identified in step b should be estimated for the horizon year using techniques consistent with Chapter 9 of this manual.

d) Estimate Directional Trip Distribution -- The directional distribution of the estimated trips in step c should be ascertained using methods consistent with Chapter 10 of this manual.

e) Traffic Assignment -- The directional traffic in step d has to be assigned to the horizon year roadway network using methods consistent with Chapter 11 of the manual.

f) Estimate Through Traffic Growth -- The existing through traffic has to be projected to the future year using some rate of growth decided by prior discussion with the reviewer.

g) Obtain Future Traffic -- Add results of step e and step f to get horizon year non-site traffic on different road networks.

h) Check Results -- Use engineering judgment to check the validity of the results obtained by the process and make adjustments, if necessary.

This method is appropriate when considering a study area with several major projects being developed during the same period as the subject project.

II. USE OF AREA/SUB-AREA TRANSPORTATION PLAN OR MODELED VOLUMES

Regional or sub-regional transportation plans generally project traffic volumes on major streets for about 20 years into the future. Often interim projections are also available. Most of the projected volumes are in ADT though some use peak hour volumes as well.

Projected traffic volumes from transportation planning studies are particularly applicable to studies of very large projects with area-wide or regional impacts and in situations where the projections have local credibility and where network details are consistent with that required for site traffic analysis in the study area. This method would also be useful for large projects in highly congested corridors where major diversion of through traffic might occur. The planning models allow reassignment of through traffic to alternate routes around the areas with the added congestion of a proposed development. This method, however, should be used where credible demographic forecasts have been or can be quickly projected for the horizon year. Great care should be taken in converting ADT to peak hour volumes.

III. TRENDS OR GROWTH RATE METHOD

This method is based on the basic assumption that recent development trends and hence traffic volumes both within and external to the study area will continue at the same rate or change predictably. If recent growth rates are not expected to continue, use of another method should be considered. Growth rates should not be normally applied in cases where the horizon year is more than 10 years. This is because the growth rates cannot be expected to remain stable for a greater period of time and the magnitude of error due to a relatively small error in the growth rate over a longer period of time.

Sometimes a combination of methods may be used to estimate future non-site traffic.

CHAPTER IX

TRIP GENERATION

Trip generation involves estimating the number of trips that will be produced from or attracted to the proposed development. This is one of the most important steps in traffic impact analysis.

ACCEPTABLE DATA SOURCES

Several sources and methods of obtaining trip generation data are available and can be used:

I. ITE TRIP GENERATION REPORT -- This report is intended for use in estimating the number of trips that may be generated by a specific land use. The total data base is derived from 1950 individual trip generation studies conducted over a span of two decades. This report enables us to estimate trip generation based on three different options:

- rate
- regression equations
- scatter plots

The estimates obtained from this source are however not to be used without sound judgment because they would correspond to the national average and would fail to take into account any special features that the subject site might have.

II. OTHER NATIONAL DATA BASES -- Two other possible sources for estimating trip generation are the NCHRP 187 [16]

and Development And Application of Trip Generation Rates [4]. The former contains trip generation rates for a variety of land uses, mostly suburban. The latter is basically an updated version of NCHRP 187 with some statistical measures of variances of the data.

II. STATE AND LOCAL DATA -- Many states, regional and local agencies have trip generation rates for sites within their jurisdiction. Appropriate agencies can be contacted to examine whether such data is available. The advantage of working with local data is that it will be more representative of the site under consideration than national data.

IV. PRIOR STUDIES -- Data from prior studies made on a similar kind of land use under similar conditions may also be used.

V. DATA COLLECTION -- If existing data are not available or are not a good representation of specialized characteristics that the site under consideration might have, a data collection effort has to be conducted at sites that exhibit similar characteristics as the study site.

RATES vs EQUATIONS

In cases where both rates and equations are available, sound judgment should be used to select the appropriate method for estimating the number of trips generated. Statistical measures available, such as R-Squared values, standard deviations, and visual evaluations should be made before making a final decision. As a general rule of thumb, the following procedure may be adopted to decide whether to use rates or equations [27]:

Step 1. Find out the trip generation rate using both the regression equation, $(Trip)_{eqn}$, and the average rate, $(Trip)_{rate}$. Calculate

$$\{(Trip)_{eqn} - (Trip)_{rate}\}/[\{(Trip)_{eqn} + (Trip)_{rate}\}/2]$$

If the ratio is less than 0.05 then either of the two can be used. Ideally, the one that most closely represents the data points in the range of the independent variable should be used. If the ratio is greater than 0.05, then go to step 2.

Step 2. Use the regression equation if

- there are more than 20 well distributed data points (for the independent variable under consideration)
- there are no predominant outliers
- the y-intercept is 0 or nearly 0, and
- the R-squared value is reasonable.

Otherwise, go to step 3.

Step 3. Determine whether the regression line or the average rate line more closely resembles the data points in the range of the independent variable. Use the one which more closely resembles the data points. If neither of them fit well or both fit equally well, go to step 4.

Step 4. Use regression equation if $R^2 > 0.75$

Use the rate if standard deviation < 110% of the average rate

If a decision still cannot be made, go to step 5.

Step 5. Use engineering judgment and find out which of the two rates found in step 1 ($Trip_{eqn}$ or $Trip_{rate}$) more closely resembles local trip generation characteristics. Refer to previous studies or collect local data.

AVERAGE vs EXTREME RATES

Most trip generation reports have an average rate accompanied by the minimum and maximum rates. In such cases, the average rate should be used as a starting point with full knowledge about the extremes. Thereafter, adjustments can be made to the average rates using engineering judgment related to site-specific issues such as vehicle occupancy, transit usage, trip generation characteristics of the adjacent area, etc.

CHOOSING THE INDEPENDENT VARIABLE

When information is available for more than one independent variable, the predictive accuracy of the variables should be taken into consideration. In the planning stage, for example, some variables are derived from others. Employment and parking are generally estimated from the floor area. Therefore, floor area is the strongest predictor variable. Similarly, acreage is usually the weakest. If the trip generation rate of a development is known for more than one predictor variables, statistical measures available like R-squared values, range, and standard deviation should be used to determine the best independent variable. If the statistical measures are more or less similar, the one with larger sample size should be used.

DAILY AND SEASONAL VARIATIONS

Trip generation estimates for the average weekday is appropriate for most traffic impact studies. But in some specialized cases, daily and seasonal variations might have to be taken into account. Hotels, airports, and recreational land uses show seasonal variations. Similarly, shopping malls, restaurants and banks show daily variations. In such cases,

the highest weekday rather than the average weekday trip generation rates should be used.

LOCATIONAL VARIATIONS

In making trip generation estimates, one should take into account where the data was collected. Trip Generation and NCHRP data were, for example, collected mostly in suburban locations or outlying areas within central cities. Adjustments to these estimates might have to be made to consider site-specific issues. Also, issues like transit availability and usage, walk-in business, ride-sharing and other demand management techniques should be given due consideration.

MIXED-USE DEVELOPMENTS

In case of mixed-use developments, certain deductions might have to be made to the trip generation rate derived by adding the trip generation rates of the individual land uses to accommodate the possibility of internal trips. Mixed-use developments have been discussed in Chapter 13 of this manual.

PASS-BY TRIPS

The methodology of handling pass-by trips has been discussed in detail in Chapter 12 of this manual.

CHAPTER X

TRIP DISTRIBUTION

After the trip generation estimates have been made, it is necessary to distribute these trips to make an assessment of the impacts of the proposed development. The outcome of the trip distribution method will be origin-destination data for generated trips.

DISTRIBUTION METHODS

Four methods of trip distribution may be used. These methods are described below:

PRIMARY MARKET

The first step in this method is to identify the influence area of the proposed development. This will correspond to the area that contains 80 percent of the trip ends that will be attracted to the site. The boundary of the study area may be delineated by any of the methods described below:

a) If a market study is available, it should be used to determine the influence area.

b) Delineate the influence area using a regular geometric shape, like a circle, with a radius corresponding to a travel time appropriate for the type of development.

c) Delineate the area by establishing the most distant points that can be reached within some selected travel time over the existing street system.

d) Use Rilley's Law of Retail Gravitation to establish the boundary between competing centers. This formulation of the gravity model considers the separation between the two competing locations as well as their relative sizes according to the following equation [2]:

$$d_A = d_{AB} / \{1+(P_B/P_A)^{1/2}\}$$

d_A = distance from center A to its primary market area boundary with center B
d_{AB} = Distance from center A to center B
P_A = size of center A
P_B = size of center B

Repeating the calculations from all competing developments will yield certain points which, when connected, will give the area of influence.

Once the area of influence has been identified, the following procedure is to be adopted:

a) Divide the area into zones.

b) Determine the amount of activity in each zone.

c) Calculate the proportion of the activity in each zone as a percentage of the primary market area.

d) Identify the logical route from the centroid of each zone to the site.

e) Calculate the directional distribution by assigning the percentages to the minimum paths.

ANALOGY METHOD

This method involves identifying an existing site with similar or nearly similar characteristics as the subject site. Data for the existing site is collected or obtained from previous studies. Data collection effort may range from a simple driveway count including turning movements to an extensive license plate survey. The methods should be consistent with the Manual of Traffic Engineering Studies [25].

SURROGATE DATA

This method involves the use of what is popularly called surrogate data [1]. This method is useful if an extensive and usable socio-economic or demographic database exists by zone or by sub-area. For example, population data can be used as surrogate data for retail trips. Employment is a reasonable surrogate for residential trips. Other trips can also be distributed using similar logical surrogates.

TRIP DISTRIBUTION MODEL

Trip distribution using gravity models may be conducted manually or by computer. In either case, the preparer must document the procedure properly. Local Metropolitan Planning Organizations have data by zones that might be used. The procedure, both manual and computerized, produces direction of

approach information and reduction in site traffic at an increased distance from the site. Hence the gravity model approach is useful when it is necessary to evaluate the traffic impacts of developments on intersections at certain distance from the site. This method, however, should be used for large projects, because for small distances from the site, the estimates are too rough.

CHAPTER XI

TRAFFIC ASSIGNMENT

Traffic assignment involves assigning the distributed trips to specific paths in the road network. Hence, the product of traffic assignment will be the total project-generated traffic by direction and by turning movements on the horizon year roadway network in the study area. Assignment should be made after taking into account logical routing, available roadway capacities and projected and perceived minimum travel times. Multiple paths should be assigned between origins and destination rather than assigning all of the traffic to the route with the shortest travel time.

The assignment may be done manually or by computer.

Procedures for assigning site and non-site trips are the same.

CHAPTER XII

PASS-BY TRIP

Shopping centers and several other convenience-oriented land use types like banks, gas stations and fast food restaurants have different trip characteristics than other land use developments. A significant portion of their trips are "captured" from the adjacent traffic stream. These trips already existed before the development. Trips to such developments may be broken down into 3 categories [5,9,10]:

- Primary
- Diverted
- Pass-by

Figure 12.1 shows primary, pass-by and diverted linked trips.

A primary trip destined to a retail facility is one in which the purpose of the trip is shopping at the site and the pattern of the trip is home-shopping-home.

A diverted linked trip to a retail facility is one in which the shopping destination is a secondary part of the primary trip, such as work to shopping to home. Thus the diverted linked trip involves a route diversion from the roadways adjacent to the site to reach a retail facility.

The pass-by trip comes directly from the traffic stream passing the facility on the adjacent roadway system and does not require a diversion from another roadway.

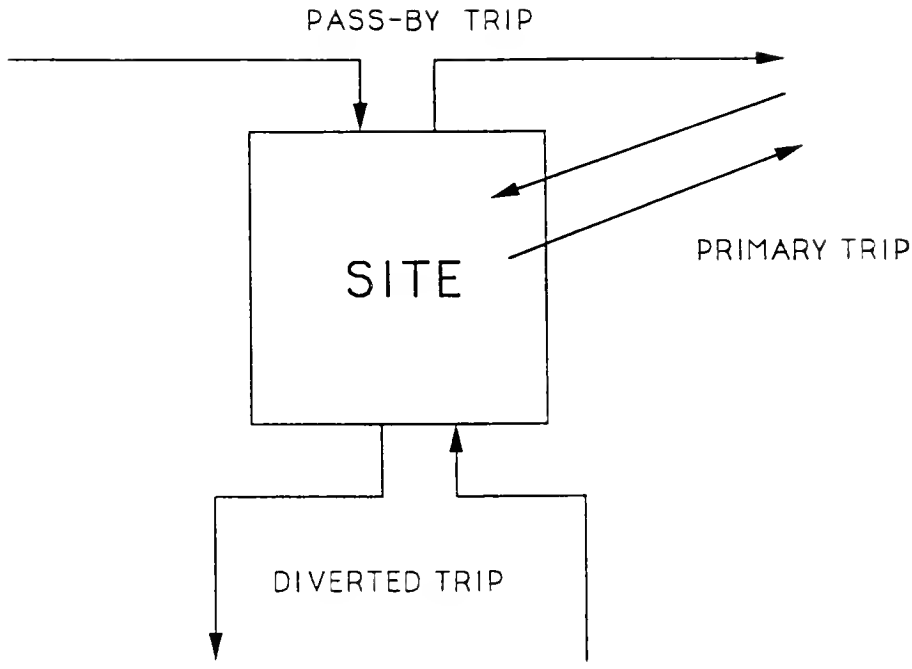

Figure 12.1. Schematic Diagram Showing Primary, Pass-by and Diverted Linked Trips

The percentage of pass-by trips vary with the size and type of development, its geographical location, time of the day, and the nature of the roadway system.

It is evident that all trips are not new to the area and a reduction in the effective trip generation rate is justified. However, it is incorrect to simply reduce the trip generation rate by the estimated pass-by percentage. This would fail to take into account the actual distribution of traffic around the site, which can have a significant impact on the outcome of the analysis. The pass-by trips can signifi-

cantly impact the turning movements once the site becomes operational.

METHODOLOGY

The methodology for handling pass-by trips during a traffic impact analysis is discussed below [7].

1) Estimate the trip generation rate as described in Chapter 5.

2) Estimate the percentage of pass-by trips. This may be done by either collecting data, using surrogate data, or using ITE Trip Generation data. Whatever the method chosen, engineering judgment should be used and there should be concurrence between the preparer and the reviewer on this matter.

3) Split the total trips generated into two separate components:

i) pass-by trips
ii) new trips

New trips include the primary and the diverted linked trips.

4) Estimate trip distribution for the two individual components separately.

5) Conduct two different traffic assignments -- one for pass-by and one for new trips. Assignments should take into account the capacity constraints and travel times on different links. The distribution and assignment of

pass-by trips will result in percentages being subtracted from some intersection approaches and being added back to another.

6) Combine the two assignments to get the final link loadings.

CHAPTER XIII

MIXED-USE DEVELOPMENTS

Mixed-use developments refer to activity centers that have a number of different land uses. In such cases it is often inappropriate to simply add up the trip generation rates of the individual land uses to determine the trip generation rate of the entire development. This is because some individuals will visit two or more destinations without leaving the site. Therefore, to estimate the trip generation rates of such developments, the number of internal trips have to be estimated and subtracted according to the following formula:

Trips generated from mixed-use development = Σ(trips generated by individual land uses) - internal trips

In the absence of local or site-specific data, the percentages given in NCHRP Report 323 [15] and ITE Trip Generation [5] can be used as a guideline for determining the percentage of internal trips.

CHAPTER XIV

ANALYSIS

Several analyses are necessary to derive the study findings, recommendations and conclusions. The different analysis that might be required are:

- Capacity Analysis
- Safety
- Site Access Points
- Traffic Control Needs
- Median Openings
- On-site Circulation and Parking
- Neighborhood impacts

For each horizon year, the analysis should be performed for the critical time period for conditions with and without the proposed development. The incremental impacts can be attributed to the subject site.

The analysis should not be ended until one of three conclusions has been reached:

1) The proposed development can be accommodated in the horizon year transportation infrastructure with no additional improvements.

2) The proposed development can be accommodated in the horizon year transportation infrastructure consistent with

agency policy and operating conditions subject to the recommended improvements/modifications.

3) The area will operate below the accepted level of service even without the development. No further significant deterioration will result if the proposed development is accommodated with the recommended changes.

CAPACITY ANALYSIS

Capacity analysis should be performed at all proposed site access points and all intersections -- both signalized and unsignalized in the study area. Other critical and congested areas of the roadway network should also be identified for analysis by the reviewing agency. Elements such as freeway weaving sections, ramps, etc. might also require capacity analysis.

Capacity analysis should be consistent with the methods described in the 1985 edition of the Highway Capacity Manual (HCM) [13]. The latest available FHWA version of the Highway Capacity Software should be used for capacity analysis.

Signalized Intersection LOS Determination

Chapter 9 of the Highway Capacity Manual suggests two methods for LOS determination for signalized intersection: planning and operational. For studies with a horizon year of less than 10 years, an operational analysis should be conducted. For a horizon year of greater than 10 years, either of the two methods can be used.

Unsignalized Intersection LOS Determination

Unsignalized intersection LOS is based on reserve capacity. The Highway Capacity Manual LOS procedure (Chapter 10) computes capacity for each movement based upon the

critical time gap required to complete the maneuver and the volume of traffic that is opposing the movement.

A gap analysis may provide assessment of whether separate turn lanes are needed. Combined with a signal warrant study, this analysis will also aid in the determination whether signalization should be considered.

Urban and Suburban Arterial

For developments along existing arterial roadways, it is necessary to assess the impact of the new traffic on the operation of the through street. Chapter 11 of the HCM describes arterial roadway capacity based on operating speed and type of facility. In the simplest case, the required analysis may consist of a time-space diagram to show that a proposed signal will, or will not, affect the platoon flow operating on the arterial. For complex cases, computer packages like the AAP, PASSER and NETSIM may be used. The study procedure and results must be documented in all the cases.

Freeway Capacity Analysis

Freeway interchange areas serving major developments have to be evaluated in terms of ramp capacities, ramp design and configuration, and weaving section capacities, as per the Highway Capacity Manual (Chapters 3 through 6). Queue storage requirements can also be developed using queueing analysis.

SAFETY ANALYSIS

Safety analysis should include identification and recommendations about high accident locations, sight distance analysis and pedestrian safety. These are discussed briefly below.

Accident Experience

The review of the existing data for the study area should include recent accident records. Locations where traffic safety should be given additional consideration should be identified. Possible methods to alleviate the existing hazards should be analyzed.

Locations having accident rates higher than one accident per million entering vehicles should be given special consideration [21].

Sight Distance

An analysis of site distances should be made to ensure that there is adequate unobstructed sight distance in both directions on all approaches to an intersection. The sight triangle for all unsignalized intersections should be determined using the space-time-velocity relationship described in A Policy on Geometric Design of Highways (AASHTO). In a signalized intersection, however, the unobstructed sight distance may be limited to the area of control [14].

Pedestrians and Bicycles

The site plan should be reviewed to ensure that the internal circulation pattern and external access points are designed for pedestrian safety and to minimize pedestrian/vehicle conflicts. Locations for transit stops and the associated pedestrian flow to and from parking facilities need careful consideration during site planning.

In case of heavy pedestrian traffic, pedestrian LOS should be determined using HCM (Chapter 13).

Due consideration should be given to bicyclists' safety and circulation.

SITE ACCESS POINTS

The site access points provide the link between the adjacent roadway system and the proposed development. Driveways provide intersections with public streets. To satisfactorily provide site access and maintain acceptable operational conditions on the adjacent streets, the agency's access control policy and standard principles must be followed. In case of multiple driveways, transportation-related needs for more than one driveway must be demonstrated.

Both street peak and site peak should be taken into consideration while analyzing the site access points.

All site access points should conform to the Indiana Driveway Handbook.

Provision should be made for vehicular storage. A 95% probability of storing all vehicles should be assumed.

TRAFFIC CONTROL NEEDS

Analysis should be carried out to determine whether traffic control warrants are met. Such warrants may be warrants for traffic signals, stop and yield signs. The warrant analysis should be according to the Indiana Manual of Uniform Traffic Control Devices [23].

MEDIAN OPENINGS

If a median opening is requested, a detailed analysis should be carried out to find out whether a median opening would hamper the operating condition of the roadway. Due consideration should be given to the following:

- warrants for a left turn signal at the opening [20]

- approach speed of the opposing vehicles
- gaps in opposing traffic
- storage space at the median opening
- queueing and delay to the vehicles
- distance from nearest intersection
- spacing between median openings [2,31]

ON-SITE REVIEW

In most cases, on-site review will not be included in a transportation impact study. For very large projects, where internal circulation system is critical, on-site review may be necessary. On-site review should include review of internal circulation and parking.

Parking

Providing adequate parking facilities for any development is of utmost importance in site planning. Insufficient parking leads to inconvenience, damage to parked vehicles, illegal parking, reduction in capacity and sight distance and consequently, congestion and accidents respectively. ITE Parking Generation [26] can be used to estimate parking demands.

Parking should be according to the existing zoning ordinance. Any variance should be requested and well documented. In case of shared parking between mixed-use developments, guidelines provided in Shared Parking [29] should be followed.

Internal Circulation

Internal circulation should provide access to all areas in a manner easily understandable to the drivers. Internal roadways should be marked and signed in accordance with recommendations in the Indiana Manual of Uniform Traffic Control Devices [23].

Consideration should be given to service and delivery vehicles and emergency vehicles in site design.

NEIGHBORHOOD IMPACTS

Neighborhood transportation impacts are primarily caused by site-generated traffic using neighborhood streets as short cuts. This can hamper pedestrian safety, air quality, community cohesion and, consequently, property values. Most neighborhoods are sensitive to this and hence an analysis should be conducted to estimate the neighborhood impacts of the proposed development and mitigating measures suggested.

CHAPTER XV

CONCLUSIONS AND RECOMMENDATIONS

If the analysis reveals that the projected traffic volumes on the horizon year roadway network will operate in a safe and efficient manner at an acceptable level of service, then no improvements are required. However if deficiencies are detected, mitigating measures have to be recommended.

These may include :

1) Installation of traffic signals

2) Installation of traffic control signs

3) Addition of lanes

4) Addition of acceleration and deceleration lanes

5) Restricted turn movements

6) Adjusting cycle lengths

7) Introducing additional signal phases

However, if reasonable mitigating measures cannot be found to make the traffic operate in an efficient way, a more detailed analysis of project size, land use and development phasing may be required. If viable transportation improvements cannot be recommended, then steps have to be taken to reduce

the trip generation rate of the proposed development during the problem period. Some of the possible approaches that may be adopted, include:

- increased transit usage
- carpool/vanpool
- congestion pricing
- reduced parking
- staggered work schedules

Several transportation demand management techniques that can reduce peak hour traffic are listed in Table 15.1.

Any of these methods finally accepted have to come with a written commitment from the petitioner to implement the necessary programs to ensure that the expected reduction occurs.

The recommendations should take into account [22]:

1) Timing of the short and long-range transportation system improvements that are already scheduled or anticipated.

2) Anticipated timings of adjacent developments.

3) Development phasings of the subject development.

4) ROW needs and availability.

5) Local priorities of transportation improvement funding.

6) Cost-effectiveness of the proposed improvements.

Table 15.1. Transportation Demand Management Techniques With Potential to Reduce Site Traffic Generation

	LIKELY VEHICLE TRIP REDUCTIONS					
MEASURES	OFFICE	RETAIL	INDUSTRIAL	RESIDENTIAL	LODGING	EVENT CENTERS
Substantial transit service to areas of trip origin	T,P	T,PM	T,P	T,P	T,P	T,P
Carpool/vanpool	T,P	T,PM	T,P	-	T,P	T,P
Modified work schedules	P	-	P	P	-	-
Parking availability reduced below normal demand level or increased parking cost	T,P	?	T,P	T,P	T,P	T,P
Internal shuttle transportation when site is part of major development well served by shuttle	T,M	T,M	-	T,M	T,P	-
Transit subsidy	T,P	-	T,P	T,P	?	?
Quality pedestrian environment on-site (mixed-use developments)	T,M	T,M	T,M	T,P,M	T,P,M	T,P,M

T = daily trips, P = peak hour trips, PM = p.m. peak hour trips, M = midday trips

RECOMMENDED PLAN OF ACTION

Implementation recommendations should be presented as a "plan of action". This action plan should recommend improvements, state why they are needed, and when they are to be implemented.

CHAPTER XVI

REPORT

The traffic impact study report should document the purpose, procedures, data sources, assumptions, findings, conclusions and recommendations of the study.

Reports should be concise and complete. It should be organized in a logical sequence and methodically take the reader through the entire process of traffic impact analysis. It should be kept in mind that the report might be of interest to the decision makers and other non-technical people. Hence, clarity should not be sacrificed.

REPORT FORMAT

Report Cover and Title Page

See Appendix C

Table of Contents

Each report should have a table of contents listing all the chapters and major sections.

List of Exhibits

A list of exhibits should be provided, which should list all the tables and figures included in the report by page number.

Some of the typical exhibits that should be included in a traffic impact study are tabulated in Table 16.1.

Executive Summary

Each traffic impact study report should begin with an executive summary. It should be one-page or two-page document to facilitate examination by the reviewing agency. It should contain the salient features of the study and should summarize the study purpose, and its conclusions and recommendations. Letters and memorandum reports under 10 pages do not need an executive summary.

Prototype Report Outline

A prototype report outline is given Appendix C.

Report Certification

The DOT may wish to require that traffic impact studies be certified by the preparer. Such certification should state that the study has been conducted according to the method described in the manual.

A report for any of the limited studies or traffic operational analyses should state in the first paragraph that the reviewer directed or agreed that only a limited study be conducted.

PUBLIC RECORD

Traffic impact study reports become public record upon submittal. Information provided in the study can be used for subsequent studies.

Table 16.1 Typical Exhibits in a Detailed Traffic Impact Study
[Source: Reference 1]

ITEM	TITLE	DESCRIPTION
Figure A	Site location	Area map showing site location and area of influence.
Figure B	Existing transportation system	Existing roadway system serving site. Should show all major & minor routes adjacent to the site.
Figure C	Existing and anticipated development	Map showing existing and anticipated land uses/ developments in study area
Figure D	Current traffic volumes	Most recent traffic volumes on roads in the study area
Figure E	Existing peak hour turning	Current peak hour turning volumes at each location critical to the study
Figure F	Anticipated transportation	Area transportation system map showing programmed and applicable planned roadways, improvements including transit, bikeways and pedestrian-ways improvements affecting site access or traffic flow through the study area.
Table A or, Figure G	Directional distribution	Map or table showing the proportion of site traffic approaching and departing the area on each roadway
Table B	Estimated site traffic generation	Analysis period site traffic generation by direction
Figure H	Site traffic	Map of horizon year roadway network showing peak hour turning volumes of site generated traffic
Table C	Trip generation of non-site development	Trips generated by off-site developments within within study area.
Figure I	Estimated non-site traffic	Map showing peak hour turning volumes due to other developments in study area and through traffic
Figure J	Estimated total horizon year traffic	Peak hour turning movements in horizon year. (Sum of figures H & I)
Figure K or, Table D	Level of Service	Level of service at critical locations under present conditions and in horizon year with & without the proposed development.
Figure L or, Table E	Recommended improvements	Table or figure showing improvements by location & type. If phasings of improvements are to be stipulated they have be shown.

CHAPTER XVII

STAFF REVIEW

The purpose of staff review is to ensure that the traffic impact study (TIS) is proceeding in the right direction and that the recommendations made by the preparer are realistic and implementable. Staff reviews are not intended to deter new developments. They are to ensure that traffic- related problems are foreseen and effective mitigation measures are identified.

Traffic impact studies should be reviewed by departments and agencies that are (a) responsible for operating the roadways, and/or (b) planning and implementing roadway improvements that are likely to be impacted by the proposed development.

FORMAL REVIEW

This review is conducted after the report has been submitted by the preparer. The formal review process should develop a list of the following findings:

- Acceptable analyses and conclusions
- Unacceptable analyses and conclusions
- Acceptability of recommended site access provisions and roadway improvements
- List of required improvements that might be considered to mitigate impacts of the proposed development.

Following the review, the reviewer(s) should send to the preparer a list of requested study revisions or a letter accepting the study.

REQUEST FOR REVISION

Any requests for study revisions should concisely indicate the findings of the formal review and clearly specify the additional information required. This additional report should be in the form of an addendum to the original study. In certain specific cases a revised report may be requested.

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APPENDIX A

SAMPLE PRELIMINARY STUDY OUTLINE

Report Cover

A. Development Name
B. Application Number
C. Applicant Name
D. Preparer Name and Organization
E. Report Date

Title Sheet

A. Development Name and Location
B. Application Number
C. Applicant's Name, Number and Telephone Number
D. Preparer's Name, Title, Organization, Address and Telephone Number
E. Date of Original Report

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List of Figures and Tables

I. Introduction

A. Purpose of Report and Study Objective

II. Proposed Development

A. Land use and Intensity
B. Area Map Showing Site Location
C. Site Plan
D. Location of nearest signalized intersection in each direction

III. Market Analysis (if applicable)

IV. Figure showing present traffic volumes at intersections to be analyzed

V. Trip Generation

VI. Trip Distribution

VII. Traffic Assignment

VIII. Figures showing horizon year traffic volumes at intersections to be analyzed with and without the proposed development

IX. Table summarizing the results of the capacity analyses for the three conditions: (a) present condition, (b) future condition without development, and (c) future condition with development

X. Summary and Conclusions

APPENDIX B

INITIAL MEETING CHECKLIST

Date: _____

Time: _____

Place: _____

People Attending

Name, Organization and Telephone #:

1) _____

2) _____

3) _____

4) _____

5) _____

Study Preparer

Preparer's Name & Title: _____

Organization: _____

Address & Telephone #: _____

_____

Reviewer(s)

Reviewer's Name & Title: _____

Organization & telephone #: _____

Reviewers's Name & Title: _____

Organization & Telephone #: _____

Applicant

Applicant's Name, Address & Telephone #: _____

_____

Proposed Development

Name: _____

Location: _____

Location Within Area:

1) CBD ____ 5) Rural ____

2) Urban (Non-CBD) ____ 6) Freeway Interchange ____

3) Suburban (Non-CBD) ____ 7) Other (Specify)

4) Suburban CBD ____ _____

Land Use Type :

ITE Code # : _____

Other : _____

Description : _____

_____

_____

Proposed # of development units: _____

_____

Zoning

Existing: _____

Comprehensive Plan Recommendation : _____

Requested: _____

Findings of the Preliminary Study:

_____

_____

_____

_____

_____

_____

_____

Study Type:

Complete _____ Traffic Operations _____

None _____

Study Area

Boundaries: _____

_____

_____

Additional Intersections to be analyzed:

_____

_____

Horizon Year(s)

_____

Analysis Time Period(s)

_____

Future Off-Site Developments

_____

_____

_____

Source of trip generation rates

_____

_____

Reductions in trip generation rates

None _____

Pass-by trips _____

Internal trips (mixed-use developments) _____

Transit Use _____

Other _____

Horizon year roadway network improvements

_____

_____

_____

_____

Methodology & Assumptions

Non-site traffic estimates: _____

_____

_____

Site-trip generation: _____

_____

Trip distribution method: _____

_____

_____

Traffic assignment method: _____

_____

Traffic Growth rate: _____

Special Features (from preliminary study or prior experience)

Accident locations: _____

_____

Sight Distance: _____

_____

_____

Queueing: _____

_____

_____

Access Location & Configuration: _____

_____

_____

Traffic Control: _____

_____

Signal System Location & Progression Needs: _____

_____

_____

On-site parking needs: _____

_____

_____

Data Sources:_____

_____

_____

_____

Base Maps: _____

_____

Prior study reports:_____

_____

Access policy and jurisdiction:_____

_____

Review Process:_____

_____

_____

Requirements:_____

_____

_____

Miscellaneous

_____

_____

_____

_____

_____

_____

_____

==========

SIGNATURES

STUDY PREPARER	REVIEWERS	APPLICANT
_____	_____	_____
	_____	

APPENDIX C

SAMPLE REPORT OUTLINE

Report Outline

A. Development Name and Location
B. Application Number
C. Applicant Name
D. Preparer Name and Organization
E. Report Date

Title Sheet

A. Development Name and Location
B. Application Number
C. Applicant's Name, Address and Telephone Number
D. Preparer's Name, Title, Organization, Address and Telephone Number
E. Date of Original Report
F. Report Revision Date

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C. Site Accessibility
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      b. proposed
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   3. Transit service
   4. Transportation system management programs

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   2. Trip distribution

3. Traffic assignment

B. Non-Site Traffic (each horizon year)
   1. Method of projection
   2. Trip generation
   3. Trip distribution
   4. Traffic Assignment

C. Total Traffic (each horizon year)

V. Analysis

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B. Capacity and Level of Service
C. Traffic Safety
D. Traffic Control
E. Site Circulation and Parking

VI. Improvement Analysis

A. Improvements to Accommodate Non-Site Traffic
   1. Physical
   2. Operational

B. Additional Improvements to Accommodate Site Traffic
   1. Physical
   2. Operational
   3. Travel demand reduction

C. Alternative Improvements
D. Status of Improvements Already Funded, Programmed or Planned
E. Evaluation

VII. Findings

A. Site Accessibility
B. Traffic Impacts
C. Additional Improvement
D. Compliance With Traffic Related Local Codes

VIII. Recommendations

A. Site Access/Circulation Plan
B. Roadway Improvements
    1. On-site
    2. Off-site
C. Transportation System Management Actions
D. Other

IX. Conclusion

A. Traffic Impact of Proposed Development
B. Adequacy of Proposed Plan Including Recommended Improvements

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